SPECIFICATION

1. Title of the Invention
Semiconductor Device Fabrication Method

2. Claims:
A method of fabrication of semiconductor devices wherein, during the applying and forming of square thermo-setting resin along said opening on the inner side of a cover plate that is hermetically sealed onto the rectangular opening of a ceramic encasing that houses semiconductor devices, such as solid-state imaging devices, a gas release slit is provided in the corner of the resin layer, and during the sealing processing stage in which said resin layer, sandwiched between said cover plate and said opening, is heated and melted, said slit is made to disappear.

3. DETAILED DESCRIPTION OF THE INVENTION

[Industrial Applicability]

The present invention relates to a method of fabrication of packaged semiconductor devices formed by hermetically sealing a rectangular cover plate in the rectangular opening of a ceramic encasing that is formed by housing semiconductor devices, such as solid-state imaging devices.

[Prior Art]

Conventionally, the following method is employed: As illustrated in Fig. 3, after a rectangular solid-state imaging device 1, a color-resolving color filter 2, and a flare-prevention film 3 are solidly attached in either a ceramic or synthetic resin encasing 4, a cover plate 6, consisting of a clear glass plate, is hermetically sealed under nitrogen gas to the rectangular opening 4 on the encasing 4.

In this operation, thermosetting resin 7 acting as a sealant is applied and formed in advance in a square pattern on the inner face of the cover plate 6, a load is applied to the cover 6 under a condition wherein the resin layer 7 is overlaid on the opening 5, and the resin layer 7 is heated and melted.

Problems to Be Solved by the Invention

However, the gas in the encasing 4 that underwent thermal expansion in the said heating/melting stage irregularly depresses the molten square resin layer 7 from the inside, and as a result, the resin layer 7, especially the inner face thereof, is deformed irregularly, adversely affecting the benefit of hermetic sealing.

In view of this fact, innovations were made wherein, as shown in Fig. 4, gas-releasing slits 8 are provided on at least two sides approximately in the middle of each side in the square resin layer 7 that is pre-applied and formed on the inner face of the cover plate 6. However, during the sealing process, the slits 8 sometimes remain without being completely eliminated. In such a situation, it is impossible to retain the nitrogen gas in the encasing 4; beyond these, because the thermo-setting resin 7 will not melt even when it is re-heated, and this results in wastage of the costly solid-state imaging device 1, the color filter 2, and other components.

According to an interpretation by the inventors of the present invention, the slit tends to remain without being eliminated when the encasing is a ceramic unit, and it was determined that the problem is related to the flatness of the sealing face of the encasing opening unit. In other words, if there are surface irregularities on the sealed face, in some spots, the spacing between the sealed face and the cover becomes uneven, such that the molten resin layer does not sufficiently stretch in the vicinity of the slit, with the result that some of the slits remain un-eliminated.

Means of Solving the Problem

The present invention involves the following: During the applying and forming of a square frame thermo-setting resin layer along the opening on the inner face of a lid that is hermetically sealed on a rectangular opening on a ceramic case that houses semiconductor devices, such as solid-state imaging devices, a slit for releasing gas is provided especially in the corners of the resin layer. Further, in the sealing processing stage wherein the resin layer sandwiched between the cover plate and the opening is heated and melted, the slit is eliminated.

Operation of the Invention

A careful observation of the sealed face in a rectangular opening in a ceramic case indicates that the heights of the four corners are uniform compared with the height of the residual part. This is due to the fact that during the heating process in the press-molding of the ceramics, expansion and contraction occur relatively uniformly in the four corners. Consequently, even if there may be surface irregularities on the periphery excluding the four corners, the molten resin layer at the four corners, pressed by the cover plate, expands uniformly, with the result that the slit can be eliminated completely.

Embodiments

The following is a detailed description of the invention with references to embodiments shown in the drawings.

As shown in Fig. 1, the cover plate 6 consisting of a rectangular glass plate has a square frame-shaped thermo-setting resin layer 9 that is applied and formed on the inner face of the cover plate by means of printing. The resin layer 9, made of epoxy resin, has gas-releasing slits 10 in the corners. It should be noted that if the resin layer 9 has a width w of approximately 1.6 mm and a thickness t of approximately 0.07 mm, the width a of the slit 10 can be set to approximately 0.3 mm.

The cover plate body thus constituted is lowered in the direction indicated by the arrow, and it is mounted on the rectangular opening of the ceramic encasing 4 that houses solid-state imaging devices. While applying a weight to the cover plate 6, the resin layer 9 is heated and melted under a nitrogen atmosphere to conduct sealing process as done in the prior art.

In this manner, even if there are surface irregularities on the sealed face of the opening, the four corners of the sealed face have a relatively even height and smoothness. Therefore, after serving the function of releasing gas as designed, the slits 10, located on the four corners are completely filled by the molten resin, and consequently disappear.

The slits 10 can be provided in the spots shown in Fig. 2; they can be provided in any of the four corners, and two or more slits can be provided.

While the above description was in reference to the fabrication of semiconductor devices in which solid-state imaging devices are semiconductor elements, this invention can also be applied to the manufacture of other package-type semiconductor devices.

Effects of the Invention

The present invention, constituted as described above, requires only slight modifications to the printing screen process that is used in the step of applying and pre-forming a square frame resin layer on the inner face of a cover plate; as such, it provides significant benefits in substantially improving the manufacturing yield in package-type semiconductor devices.

4. Brief Description of the Drawings

Fig. 1 is a decomposition perspective view of the critical parts of the semiconductor device made by the fabrication method of the present invention. Fig. 2 is a planar diagram of a cover plate structure employed in another embodiment of the present invention. Fig. 3 is a partial cross-sectional perspective diagram of a package-type semiconductor device. Fig. 4 is a planar view of a conventional cover plate structure.

1. Solid-state imaging device
4. Encasing
6 Cover plate
9 Resin layer
10 Slit

Fig. 1
Fig. 2
Fig. 3
Fig. 4